The Marine Biologist

The magazine of the marine biological community

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Editorial

Welcome to *The Marine Biologist* magazine. We always strive to include interesting and illuminating material from all over the world and in this 'Asia edition' we hear from marine biologists in India, Sri Lanka and Japan – see below.

Marine biologists are a diverse community, but does our focus on one realm mean we are more likely even than other scientists to stay in our salty 'silo'? As Murray Roberts says on page 39, describing the new Lyell Centre, "we cannot do our best work as marine biologists in isolation". Clearly, we need to maximize opportunities for collaboration at the boundaries of disciplines – a theme for a future edition, perhaps.

Also in this edition: Pawel Burkhardt explores the origin of nervous systems, we dream of a digital ocean and discover resources such as a new plankton guide and an app to help tourists enjoy unfamiliar fish. Science and politics is rarely a harmonious mix, particularly when it comes to marine protected areas. The practical and moral case for the creation of large marine reserves in tropical shallow marine habitats is made (p. 16), and we look at a new book which questions the efficacy of marine reserves as a fisheries management tool (Reviews, p. 36).

MBA members hail from many countries (currently 44), including India. I am delighted to hand this editorial over to the Secretary of the the Marine Biological Association of India (MBAI), Dr. K. Sunil Mohamed.

Guy Baker

With 3 million Indians directly and indirectly dependent on marine fisheries, knowledge of marine biology of the seas around India is of the utmost importance. India accounts for less than 0.25 per cent of the world's total coastline; however, 171 million people live in India's coastal districts (approximately 5 per cent of the world's coastal population and 14 per cent of India's total population). Therefore, it is not surprising that these coastal zones are witnessing increasing economic activity resulting in loss or degradation of critical marine habitats, overfishing and pollution, and the associated impacts on ecosystem services. On top of this, the coasts are adversely impacted by floods, cyclones and severe storms. According to recent estimates by the Intergovernmental Panel on Climate Change, sea levels in India are expected to rise at the rate of 2.4 mm a year, and by 2050, the total increase may displace thousands of coastal people. This combination of natural and human forces and the uncertainties involved in their origins and impacts presents a major challenge to coastal people of India.

In this scenario, the challenges in managing such complex ecosystems are enormous and there appear to be no ready answers. Looking to the future, the strength that India has in marine biology and allied sciences will stand her in good stead to minimize these impacts. Another asset that India has is the high biodiversity in her seas (see p. 19) which is already being targeted by researchers for novel drugs and chemicals. The high diversity in fished taxa and the inherently high regenerative capacity of tropical fish stocks may also be helping in sustaining India's largely uncontrolled fisheries. Cross-learning from other developed and developing nations with similar situations and problems must be a way forward.

With advice from marine biologists, the Government of India has brought into force a number of laws for the conservation of marine species and habitats. Indian marine scientists continue to bring evidence from the latest research to formulate new policies to help mitigate human impacts and allow damaged ecosystems to recover.

Dr. K. Sunil Mohamed, Secretary of the Marine Biological Association of India

Front cover: A flock of flesh-footed shearwater (*Ardenna carneipes*) feeding on oil sardine in the southeast Arabian Sea. Image: R. Jeyabaskaran.
Back cover: Making a comeback? The spiny lobster (*Palinurus elephas*), needle rock, Lundy, southwest England. Image: Keith Hiscock.

Contents

Issue 5. October 2015

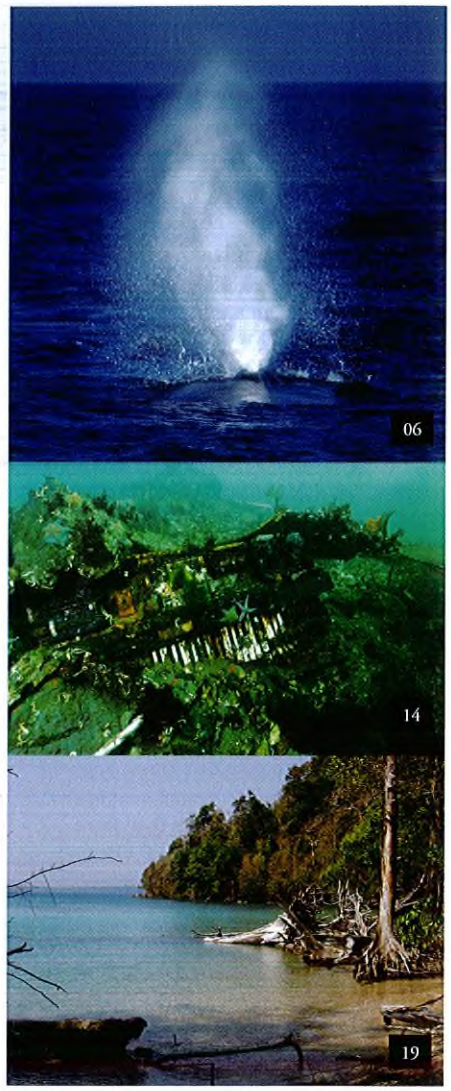

Image credits: Top: Asha de Vos.
Middle: Sanriku Volunteer Divers.
Bottom: Sunil Mohamed.

Image: Ajin Madhav

Indian seas – a megadiversity hotspot

By N.R. Menon and N.G.K. Pillai of The Marine Biological Association of India

Marine biological research in India dates back to the 18th century, and the surveys and expeditions conducted by Europeans, particularly the British. The most notable among these pioneers were great naturalists such as Francis Day (1829–1889), Nelson Annandale (1876–1924) and Herbert Robinson (1874–1929) who worked during the latter part of the 19th century and early 20th century. This foundation helped India to create a network of marine research laboratories in government funded institutions and universities all along the coastline. From the early days of taxonomic descriptions and records of marine fauna and flora, marine biological research in India has moved to advanced biology, physiology, biochemistry, microbiology, molecular biology and ecology of marine organisms.

India has a coastline of 8,129 km bounded by the Arabian Sea to the west and the Bay of Bengal to the east. The Indian Ocean lies south of its peninsula. With an exclusive economic zone spanning 2.02 million km2 and a continental shelf area of 0.53 million km2, the Indian marine environment harbours 15% of the global biodiversity. Of the 32 animal phyla, 15 are represented in India's marine ecosystem, with more than 15,000 species. The region has exceptionally high species richness, including over 3,000 species of fish, compared with around 1,200 in the next richest marine region, the western Atlantic, and around 500 species of reef building corals compared with about 50 species in the western Atlantic. India is one among the 12 mega-biodiversity countries with a wide range of coastal ecosystems such as estuaries, lagoons, mangroves, salt marshes, mud flats, rocky, sandy and muddy coasts, coral reefs, seaweeds, seagrass beds and more. They serve as nurseries for both fish and shellfish, many of which are commercially exploited. The Indian peninsula is bounded by 3 gulfs, the Gulf of Mannar on the east coast, and the Gulf of Kachchh and Gulf of Khambhat on the west coast. The east coast of India is endowed with the world's largest mangrove forest, the Gangetic Sunderbans. All three major reef types – fringing reef, barrier reef and atoll – are present in India. A network of 14 major, 44 medium and numerous minor rivers traverse through the country before they empty into the Arabian Sea and the Bay of Bengal. There are 17 lagoons (8 on the east coast and 9 on the west coast) along the Indian coast.

the Indian marine environment harbours 15% of the global biodiversity

Fishers engaged in a modern version of traditional boat seine fishing for small pelagic species. Image: R. Jeyabaskaran.

The oceanography of the Indian seas is

Box 1. The Central Marine Fisheries Research Institute (CMFRI) (www.cmfri.org.in) is the largest and one of the oldest (established 1947) marine laboratories in India. With its headquarters in Kochi on the south-west coast, it has nine research locations distributed on both coasts and employs more than 120 scientists. It has facilities to address research on marine taxonomy, biodiversity, environment, biotechnology and socio-economics, besides fisheries. The Marine Biological Association of India (MBAI) owes its origin to erstwhile researchers of the CMFRI and is currently housed within its campus.

influenced by the two tropical monsoons, the south-west and north-east and this shapes the physical features of the east and west coast of India. The west coast is characterized by heavy surf and rocky shores, islands formed of oceanic atolls, intense upwelling, mud banks and high primary productivity. The ephemeral mud banks of Kerala (along the south-west coast) are a unique phenomenon appearing during the south-west monsoon. Fishermen come from far and wide to harvest tonnes of fish from traditional canoes. The east coast on the other hand has extensive beaches, lagoons, deltas and marshes, islands of mainly continental and volcanic origin, weak upwelling during the north-east monsoon and lower primary, secondary and fish production than the Arabian Sea.

Microorganisms represent the largest reservoir of biodiversity in India and research on marine microbes is booming. Microbes of the seas including fungi and bacteria in coastal, offshore and deep sea waters are being targeted by researchers. Among the microalgae that contribute to the primary production in the Indian seas, diatoms make up 52 per cent, followed by dinoflagellates. Altogether over 800 species of phytoplankters have been recorded from the Indian seas. A total of 844 species of seaweeds distributed among 217 genera are known from Indian seas. Seagrasses form an integral part of many ecosystems and so far 14 species have been recorded. The Indian mangroves cover about 4,827 km2 and a total of 39 mangrove species are known from India.

Studies on the sponges of the Indian Ocean started in 1765. So far 486 species of marine sponges are known to occur in Indian seas. Coral reefs are found in the Palk Bay, Gulf of Mannar, Gulf of Kachchh, central west-coast of India, Lakshadweep and around the Andaman and Nicobar islands. A total of 50 genera and 13 sub-genera of reef-building corals are known to occur in Indian reefs. Many of the lower marine invertebrates are targets of research for development of drugs and molecules useful to man.

A wide diversity of crustaceans (2,934 species), molluscs (3,370 species), echinoderms (765 species), cephalochordates (6 species), ascidians (47 species), thaliaceans (48 species), fish (2,456 species), sea snakes (26 species), sea turtles (5 species) and marine mammals (25 species) are reported from Indian waters.

The marine fisheries sector plays a vital role in the Indian economy. It addresses food and nutritional security, employment and livelihood support. Its exports are worth more than US$ 5 billion annually. The sector provides employment and income to over three million fishers. The annual marine fish production recorded tremendous growth during the post-independence era from 0.6 million tonnes in 1950 to 3.94 million tonnes during 2012. Fishery resources are made up of a large number of coexisting species, making the fisheries multi-species and multi-gear with inherent complexities in management. Several sea farming technologies have been developed for farming shrimps, lobsters, oysters, mussels, clams, seaweeds, sea cucumbers, finfish and for the production of marine pearls. While shellfish are now being farmed extensively along the coastal areas, other technologies await adoption and commercialization. Much of the work on fisheries has been carried out at the Central Marine Fisheries Research Institute (see Box 1.).

Habitat loss, uncontrolled developmental activities in the coastal zone, climate change impacts, over-exploitation of resources, coastal pollution, haphazard beach fortification, sand mining and drilling operations are among the threats to marine life of the Indian seas. With advice from marine biologists, the Government of India has brought into force a number of laws (the Biological Diversity Act, 2002, the Indian Wildlife Protection Act 1972, and the Marine Fisheries Regulation Acts of Indian maritime states are examples) for the conservation of marine organisms and their habitats.

N.R. Menon and N.G.K. Pillai are Vice Presidents of The Marine Biological Association of India (www.mbai.org.in).